Biometric and Taxonomic Analysis of the Genus *Isotelus* (Trilobita) from Cincinnatian (Upper Ordovician) Rocks of Ohio, Kentucky, and Indiana

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ABSTRACT

Three species of the trilobite genus *Isotelus* are commonly cited from Upper Ordovician (Cincinnatian) rocks of southwestern Ohio and adjacent areas of Kentucky and Indiana. They are: 1, *I. gigas* DeKay, 1824, which was first described from the Trenton Limestone of New York; 2, *I. maximus* Locke, 1838, which was first described from Cincinnatian rocks of Ohio; and 3, *I. brachycephalus* Foerste, 1910, which was first described from Cincinnatian rocks of Ohio. Holaspid specimens of *I. gigas* are easy to distinguish from the other two species by the lack of genal spines. However, *I. maximus* and *I. brachycephalus* are extremely similar morphologically and recently it has been hypothesized that they are conspecific. Foerste's (1910) criterion for distinguishing *I. brachycephalus* from *I. maximus* was that *I. brachycephalus* supposedly had a wider exoskeleton. Well-preserved specimens referable to *I. maximus*, *I. brachycephalus*, and *I. gigas* were statistically analyzed using regression analysis to determine the exact number of species in Ohio. Based on this quantitative analysis, I found there to be no consistent morphological differences between *I. maximus* and *I. brachycephalus*; *I. brachycephalus* is therefore considered to be a junior synonym of *I. maximus*. In light of this work, only two species of *Isotelus*, *I. gigas* and *I. maximus*, seem to be present in Cincinnatian rocks of Ohio, Kentucky, and Indiana.

INTRODUCTION

The Ordovician trilobite genus *Isotelus* is one of the largest and most distinctive trilobites known. The genus was described by DeKay (1824) from specimens found in the Trenton Limestone of north-central New York. Members of the genus are among the most common of Ordovician trilobites from North American rocks, and more than a dozen species have been described. The genus is distinctive (see Figure 23), being characterized by an oval outline, a cephalon and pygidium that are subtriangular in outline and subequal in size, a concave border on the cephalon and pygidium, an effaced dorsal surface, and a large forked labrum (hypostome).

Individual sclerites of *Isotelus* are common in Ordovician rocks of Ohio, Kentucky, and Indiana. Complete specimens, which are less common, sometimes exceed 50 cm in length. These facts probably influenced the Ohio Legislature to designate the genus as the State Invertebrate Fossil in 1985. Three species of *Isotelus* have been cited from Cincinnatian strata of Ohio and adjacent areas, and it is possible that some of them are synonyms. Some preliminary studies of species included in *Isotelus* have suggested that the genus has been split into more species than the number that good, large collections warrant (e.g., Ludvigsen, 1979; Babcock, 1993). This question has been never before approached in a rigorous manner despite the availability of good collections of well-preserved material. A revision of the genus *Isotelus* is long overdue but before that is possible, it is necessary to assess the range of morphological variability possible within some species of the genus, and to assess the biologic and taphonomic factors that may influence that morphologic variability.

The purpose of this study is to quantitatively and qualitatively analyze some described species of *Isotelus*, particularly the three species most commonly cited from Upper Ordovician (Cincinnatian) rocks of southwestern Ohio, northern Kentucky, and southeastern Indiana. Those species are *I. maximus, I. gigas,* and *I. brachycephalus.*

MATERIALS AND METHODS

Specimens used in this study are in collections of the Orton Museum of The Ohio State University (OSU), the University of Cincinnati Geology Museum (UCGM), and the Cincinnati Museum of Natural History (CiMNH). Measured specimens were biometrically analyzed using the Optimus image analysis package and statistically analyzed using StatView SE + Graphics.

STRATIGRAPHY

The Cincinnatian Series in the type region is a richly fossiliferous interval characterized by interbedded carbonate and siliciclastic rocks. These rocks represent deposition in a warm shallow sea that covered much of the Laurentian craton during the Late Ordovician Period. Cincinnatian rocks are among the most commonly studied strata in the world, and through the years, several different stratigraphic schemes have emerged. Among them are ones emphasizing biostratigraphy (Caster et al., 1955), ones emphasizing lithostratigraphy (e.g., Ford, 1967), and one emphasizing sequences stratigraphic patterns (Holland, 1993). The Ohio Division of Geological Survey has recently adopted a stratigraphic scheme that combines biostratigraphic and lithostratigraphic divisions (Hull, 1990). Further confounding the stratigraphic nomenclature of the Cincinnatian Series is the fact that the state geological surveys of Ohio, Kentucky, and Indiana do not always agree on stratigraphic usage (see Davis, 1992, p. 14). For the purpose of simplicity, I will use the biostratigraphically-based terminology of Davis (1992, p. 13) in this thesis.

Edenian

The Edenian strata consist mostly of bluish shales with limestones partings; the relative proportion of limestone increases upsection. The fauna of the Eden seems to indicate a connection of the Ordovician sea with that of the St. Lawrence Valley area (Davis, 1992). The Eden shales and limestones disappear to the south and west (Davis, 1992). *Isotelus* sclerites are uncommon in the Edenian.

Maysvillian

Maysville strata are conspicuously more calcareous than strata of the Eden although shales still predominate. The fauna is large and distinctive (Davis, 1992), and *Isotelus* sclerites are present in places.

Fairview Formation: It consists of an unbroken sequence of interbedded limestone and terrigenous rocks in which no stratum is persistently thicker than 1.5 feet (Ford, 1967). This formation is divisible into two units, the Mt. Hope and Fairmount members. The base of the Mt. Hope member is marked by the appearance of *Platystrophia* and *Escharopora*. The overlying Fairmount Member contains some layers of crinoidal limestone (Davis, 1992).

McMillan Formation, Bellvue Member: The Bellvue Member is defined as an interval of medium to thin-bedded limestone and shale in which thin bedded, massive, coquinite limestone predominates (Ford, 1967). It marks a change from the conditions of deposition recorded in the Fairmount Limestone. Muds are present, and there is evidence of current action in the form of shell rubble and layers of edgewise-stacked shells. Solution cavities in the calcareous Bellvue frequently cause sinkhole topography in the Cincinnati uplands. The most distinctive feature of this member is the ponderous shells and massive bryozoans it contains. Commonly the limestone of the Bellvue Member exists only as erosional remnants on the hilltops of Cincinnati. The thickness of this unit increases to the south as it exyends into Kentucky (Ford, 1967).

McMillan Formation, Corryville Member: This is predominately a shale unit. It occurs near the hilltops in the Cincinnati area. This is the most interesting unit for collecting fossils. It contains a many good trilobite specimens (particularly *Flexicalymene* but also some specimens of

Isotelus and other other genera).

McMillan Formation, Mount Auburn Member: The Mount Auburn forms hill caps around Cincinnati. It consists of rubbly mudstone, in some localities it may be seen as an impure limestone (Davis, 1992).

Richmondian

There is no major change in lithology from the Maysville deposits to the base of the Richmondian. The base of the Richmondian is instead defined by the appearance of a variety of fossils including the brachiopods *Leptaena richmondensis* and *Strphomena planumbona* (Davis,1992). The Richmondian is the unit from which most *Isotelus* remains in Ohio, Kentucky, and Indiana have been collected. Most large, complete specimens have been collected from the Arnheim Formation.

Arnheim Formation: The Arnheim is typically rich in shelly fossils. Oftentimes the fossils are abraded. The unit thickens and thins considerably in the Cincinnati area, and commonly has a rubbly appearance on the outcrop.

Waynesville Formation: This formation is composed of repetitious, even-bedded limestone and blue shale beds. The yellowish clay shale beds produce great numbers of *Flexicalymene* trilobites. The Blanchester Member, at the top of the Waynesville, is an extremely fossiliferous interval of shales (Davis, 1992).

Liberty Formation: Lithologically this formation is similar to the Waynesville, although it contains more limestone beds (Davis, 1992).

Whitewater Formation: The Lower Whitewater Member is composed largely of limestones that commonly show current eroded channels. The middle of the Whitewater Formation (Saluda Member) is a massive limestone unit. The Upper Whitewater Member is lithologically similar to the lower part of the formation (Davis, 1992).

Elkhorn Formation: The lower part of the formation is a shale that contains a sparse fauna.

The upper Elkhorn is a granular, dolomitic limestone, which makes fossil collecting difficult (Davis, 1992).

ISOTELUS IN CINCINNATIAN ROCKS

Fourteen species of *Isotelus* have been described from North America. A list of all described *Isotelus* species, with differential characters noted, is given in Table 1. I have not personally observed specimens of all described species, but for most have referred to cited original references indicating the species characteristics. The type specimens of most described species of the genus could not be located in North American collections, and it is possible that many of them are lost. Specimens actually observed by me are referable to *I. gigas, I. maximus,* and *I. iowensis.*

Isotelus maximus Locke, 1838.--This species was described by Locke (1838) from two specimens found in the Liberty Formation (Richmondian), a short distance above the mouth of Trebis Run, 8 miles (13 km) southwest of Peebles, Ohio (Foerste, 1910). The specimens were described as being from the collection of Dr. John Locke but the present repository of them is unknown. It is possible that the specimens have been lost. Locke's specimens were from a strongly rippled layer of limestone. They showed no genal spines, and Locke's reconstruction may have been somewhat conjectual. Locke (1842) renamed his species *I. maximus* as *Isotelus megistos* using the same two specimens that he described in 1838. Locke, as justification for the name change, stated "These gigantic dimensions suggested the name maximus, which I gave in the Ohio report, but for obvious reasons I have changed to the more classical Greek term of the same import." According to the International Code of Zoological Nomenclature, the name *I. maximus* has priority, and *I. megistos* is therefore an objective junior synonym.

Isotelus brachycephalus Foerste, 1910.--The holotype of this species was found along the western end of the excavation for the conduit beneath the Huffman Conservancy dam, six miles (10 km) northeast of the center of Dayton, 162 feet (53 m) below the base of the Brassfield Formation (Foerste,1910). This specimen was found dorsal side down imbedded in an indurated clay layer. The specimen was first displayed in a local elementary school. Eventually, the specimen was deposited in the U.S. National Museum (USNM).

Foerste (1910) stated that the difference between *I. maximus* and *I. brachycephalus* was in the width to length body ratio. Foerste stated "Both the Huffman Conservancy dam specimen and the Roaring Run specimen are characterized by cephalons and pygidia which are remarkably short compared to their width." (Foerste, 1910). Both *I. maximus* and *I. brachycephalus* have genal spines and are of large size.

Isotelus gigas DeKay, 1824.--This species, the type species of the genus, was first described from the Trenton Limestone of New York (DeKay, 1824). *I. gigas* differs from specimens referable to both *I. maximus* and *I. brachycephalus* in that it lacks genal spines in large holaspid specimens. Meraspides and young holaspides do evidently possess genal spines, however. It is difficult to distinguish isolated cephala and pygidia of *I. gigas* from those of *I. maximus* but, according to Raymond (1914), "If the pygidium has straight sides, it can quickly be placed as *I. gigas*. If the posterior end is rounded, it might be taken for either *I. iowensis* or *I. maximus*, but if the ratio of length to breadth is above .65 it is probably *I. iowensis*, and if below *I. maximus*."

BIOMETRIC ANALYSIS

The measured specimens were statistically analyzed using regression analysis. Most quantitative descriptors were defined by Shaw (1957) or Temple (1975). The collected data are given in Tables 1 and 2. Results of regression analysis for specimens referable to *I. maximus* and *I. brachycephalus* are given in Figures 1-11. Among the 13 variables measured on the cephalon and pygidium, there seems to be no indication of any consistent, quantitative difference between large holaspid specimens referred *a priori* to *I. maximus* and *I. brachycephalus*. In fact, r^2 values for all analyzed measurements exceed 0.9, which strongly suggests that only one species is represented by the analyzed specimens. For comparison, similar regression analyses were peformed on specimens referable to *I. gigas* (Figures 12-21). The variance among these specimens is greater than that seen in the previous set of analyses, although some of this additional variance may be an artifact of a relatively small sample size.

Is Foerste's (1910) claim correct, namely that *I. brachycephalus* differs from *I. maximus* in the short length compared to its width? Results of regression analysis on characters of the cephalon (Figures 2-8, 10, 11) and on the pygidium (Figures 1, 9) do not support that hypothesis. How then can the supposed differences between specimens of *I. maximus* and *I. brachycephalus* (see Figure 23) be explained? From examination of the holotype of *I. brachycephalus*, which is on display in the U.S. National Museum, it is apparent that Foerste's specimen has been severely compacted in shale, similar to an OSU specimen illustrated here (Figure 23.8). Compacted specimens (such as those in Figures 23.4, 23.5, 23.8), which are commonly preserved in soft shale or clay, tend to be referred to *I. brachycephalus* whereas relatively uncompacted specimens (Figures 23.2, 23.7), which are commonly preserved in limestone, tend to be referred to *I. maximus*. Specimens preserved in the highly compacted shales or clays tend to have somewhat greater spreading of sclerites, especially in the areas of the genal spines. As the regression analyses demonstrate, however, the amount of quantifiable distortion that results from compaction is rather minimal in the x-y (horizontal) plane. Obviously compaction is responsible for considerable distortion in the z (vertical) plane.

CONCLUSION

After a qualitative and quantitative analysis of specimens referable to *I. maximus* and *I. brachycephalus*, I feel safe in concluding that *I. brachycephalus* is a junior synonym of *I. maximus*. Thus, I recognize only two species of *Isotelus* in Cincinnatian strata of Ohio, Kentucky, and Indiana. They are *I. maximus* and *I. gigas*. Foerste's (1910) observation that *I. brachycephalus* is wider than *I. maximus* may have been an optical illusion due in part to severe compaction of the holotype in shale.

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Table 1. List of differential characters for described species of *Isotelus* from North America. Except for *I. gigas, I. maximus,* and *I. iowensis,* the indicated characters are taken from the respective authors' original descriptions.

	CEPHALON	THORAX	PYGIDIUM
I. gigas	Genal spines absent		Interpleural furrows distinct
I. maximus	Genal spines long		Shorter and wider than I.gigas
	Shorter and wider than I.gigas		
I. iowensis	Long genal spines		Short and wide
	Elongated compared to width		Interpleural furrows distinct
			Elon[illegible]d compared to width
I. latus	Border concave, widest at anterior		
I. ottawensis	Eyes close to the rear and closer together		
I. platycephalus *(A.platycephalus)*	Border not raised		
	Facial sutures meet anteriorly		
	Genal spines absent at maturity		
I. brachycephalus *Foerste,1910*	Short compared to width		Short compared to width
I. canalis		Form of the plates is different than I.gigas	
(Asaphus canalis)			
Conrad,1889			
I. susae		Axis sharply defined	Axial furrows deep and distinct
(Asaphus susae)			
Whitfield,1882			
I. megistos			
(I.maximus)			
Locke,1842			
I. planus	Outline more rounded than I.gigas		
Green,1832			
I. cyclops	Head of species is much more elongated than that of I.gigas		
Green,1832			
I. megalops	Differs from I.gigas in the magnitude and contour of the eyes		
Green,1832			
I. stegops	Eyes prominant and nearer to lateral edge than I.gigas		
Green,1832			

Table 2. Chart of *I. maximus* measurements used in regression analysis. Refer to Figure 22 for corresponding measurements.

	1	2	3	4	5	6	7	8	9	10	11	12	13	specimen no.	lithology	Name
1	3.42	2.96	3.34	2.52	.87	1.34	•	•	4.07	•	4.13	4.56	6.38	UCGM 31685	wackestone	I.maximus
2	3.78	3.81	3.87	•	.85	1.57	6.81	•	4.63	1.67	3.86	3.76	5.98	CIMNH P577	wackestone	I.maximus
3	5.36	3.56	5.18	4.13	•	2.34	•	•	6.35	•	•	6.22	8.54	CIMNH PT555	mudstone	I.brachy.
4	•	•	6.41	4.76	1.12	•	•	•	•	•	•	•	•	CIMNH PT655	mudstone	I.brachy.
5	3.10	•	4.28	•	.96	1.05	•	•	3.84	•	3.61	2.48	4.94	OSU 19537	mudstone	I.maximus
6	1.64	•	2.06	•	.55	.60	3.37	•	2.03	•	2.30	2.06	3.32	OSU 19537	calc.shale	I.brachy.
7	4.31	4.08	3.70	3.17	.79	2.25	•	•	•	•	•	•	•	OSU 14714	mudstone	I.brachy.
8	1.67	1.54	2.22	1.74	.49	.77	3.76	2.08	2.08	•	2.08	1.63	3.67	OSU 14714	mudstone	I.brachy.
9	•	•	•	•	•	•	•	•	•	•	6.24	4.45	8.90	OSU 23285	packstone	I.maximus
10	3.83	•	•	•	•	1.11	6.24	3.02	4.20	1.97	•	3.06	5.52	CIMNH P506	wackestone	I.maximus
11	•	•	•	•	•	•	4.56	•	•	•	2.82	•	4.73	CIMNH P506	wackestone	I.maximus
12	3.80	•	6.32	•	.79	1.42	•	•	•	•	4.02	•	9.91	OSU 34023	limestone	I.brachy.
13	2.77	•	3.22	•	.60	.85	5.13	2.39	2.85	•	3.28	1.96	4.81	OSU 127	plaster cast	I.maximus
14	3.91	•	4.05	•	.93	1.26	6.62	•	4.30	•	5.01	3.42	6.44	OSU 126	plaster cast	I.maximus
15	•	•	•	•	•	•	•	•	•	•	5.20	•	8.66	OSU 23428E	calc.shale	I.brachy.
16	•	•	•	•	•	•	•	•	•	•	3.43	•	5.24	OSU 23428B	calc.shale	I.brachy.
17	14.21	•	12.69	•	2.15	7.17	29.97	•	14.67	•	16.01	•	27.72	OSU, no. #	calc.shale	I.brachy.
18	4.55	4.84	5.58	4.34	.96	1.71	4.58	•	5.01	•	5.61	•	8.08	OSU 18595	calc.shale	I.brachy.
19	•	•	•	•	•	•	•	•	•	•	8.05	•	12.58	OSU 19961	foss.muds...	I.brachy.
20	7.81	7.23	7.71	•	1.31	3.70	17.81	12.22	8.27	•	9.50	•	15.22	OSU 32701	wackestone	I.maximus
21	•	•	•	•	1.42	7.15	•	•	•	•	12.57	•	19.26	OSU 20402	calc.shale	I.brachy.
22	2.85	2.98	2.95	2.25	.55	1.00	5.08	3.20	3.53	1.04	2.39	•	4.23	CIMNH P51	wackestone	I.maximus

Table 3. Chart of *I. gigas* measurements used in regression analysis. Refer to Figure 22 for corresponding measurements.

	1	2	3	4	5	6	7	8	9	10	11	12	13	specimen no.	lithology
1	3.10	2.22	3.22	2.62	.68	.91	4.73	3.39	3.18	•	2.98	•	4.44	CIMNH P49	Black LS/N.Y.
2	2.39	1.99	2.57	1.77	.60	.77	3.97	3.20	2.74	•	2.93	2.51	3.59	UCGM 39411	LS
3	1.67	•	2.20	•	.50	.77	•	•	2.00	•	1.89	1.91	3.50	CIMNH PT423	
4	2.49	2.16	2.74	1.83	.82	1.29	•	•	2.77	•	3.23	•	4.10	CIMNH PT618	
5	•	•	•	•	•	•	•	•	•	•	2.08	3.02	4.58	OSU 80105	
6	1.34	.80	1.20	.97	.41	.60	1.74	•	1.59	•	1.20	.74	1.82	OSU 46325	

I.maximus Z vs. W

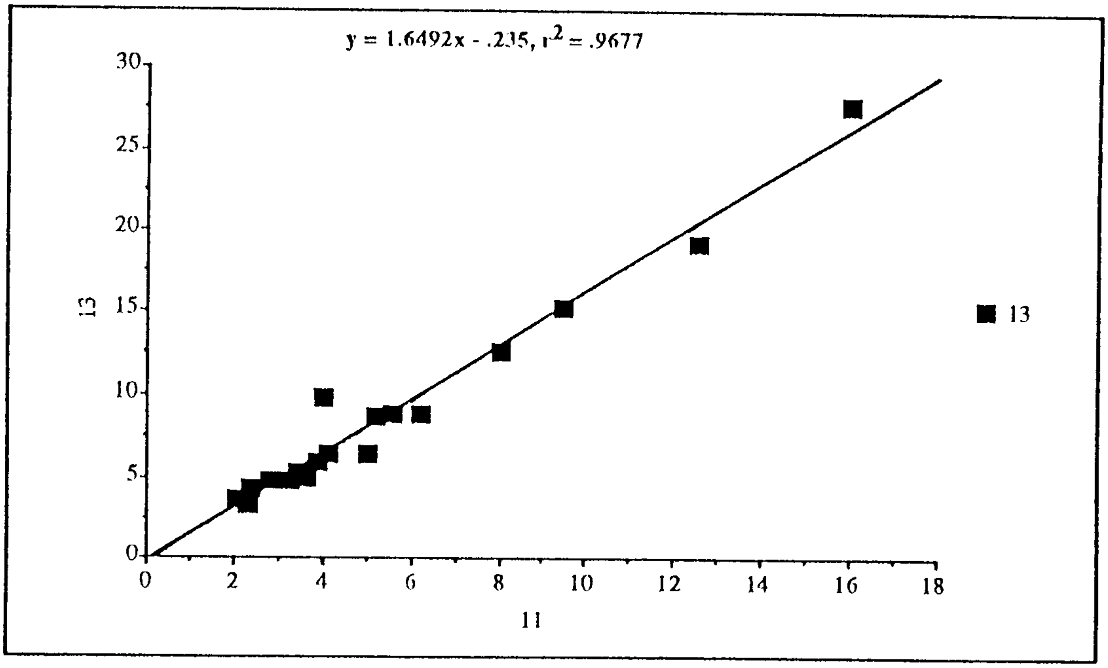


Figure 1. Regression analysis of pygidial length (measurement 11, Z) versus pygidial width (Measurement 13, W) for *I. maximus*.

I.maximus A-2 vs. J-5

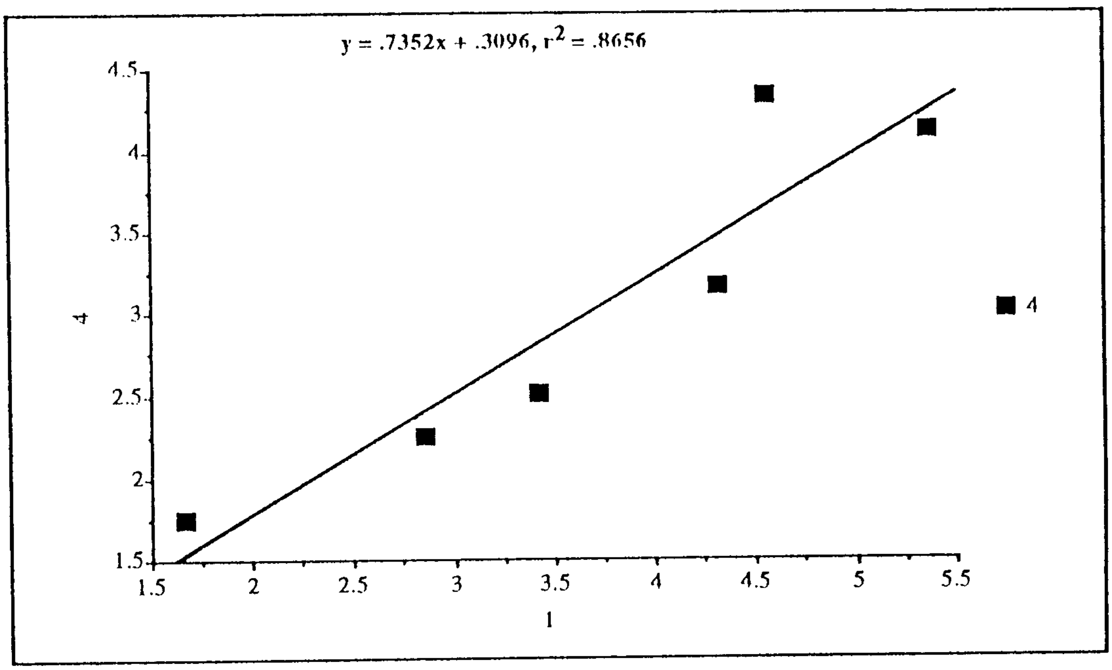


Figure 2. Regression analysis of cephalon length (measurement 1, A2) versus post-palpebral cranidial width (Measurement 4,J5) for *I. maximus*.

I.maximus A-2 vs. M-5

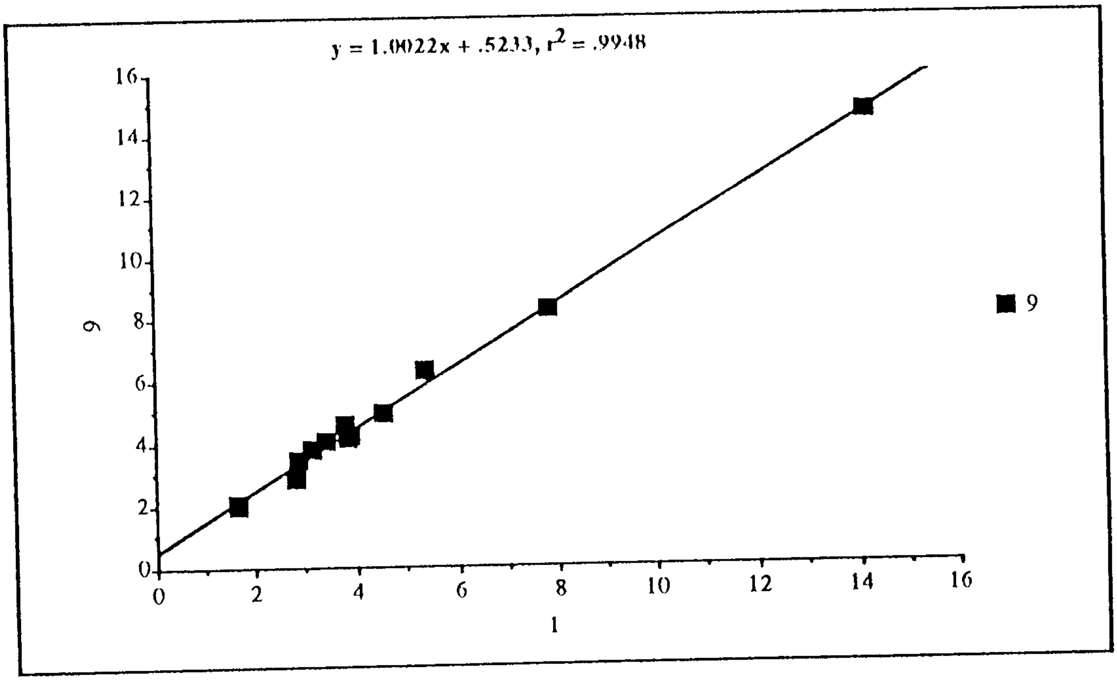


Figure 3. Regression analysis of cephalon length (Measurement 1, A2) versus length of free cheek (measurement 9, M5) for *I. maximus*.

I. mximus A-2 vs. M-6

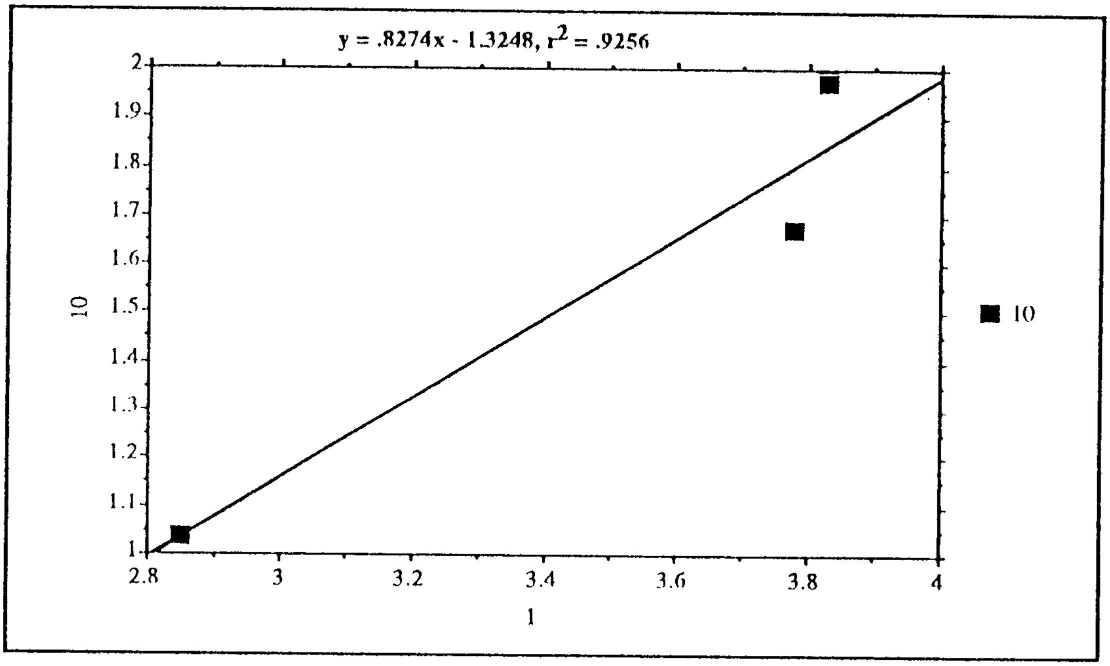


Figure 4. Regression analysis of cephalon length (Measurement 1, A2) versus length of genal spine (measurement 10, M6) for *I. maximus.*

I.maximus A-2 vs. J

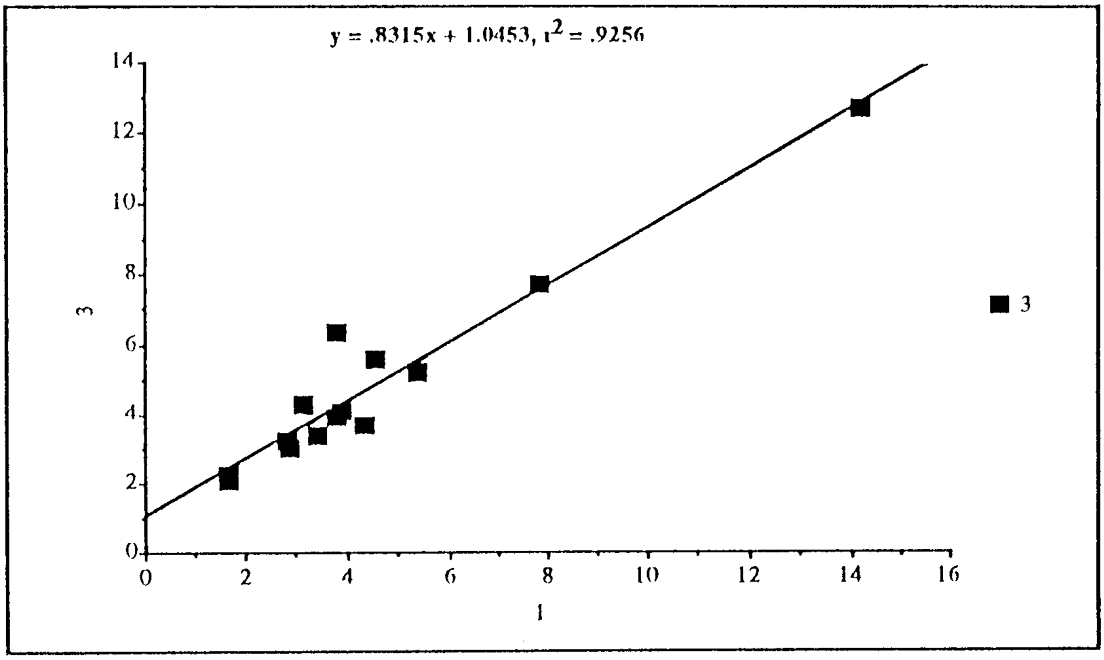


Figure 5. Regression analysis of cephalon length (Measurement 1, A2) versus palpebral cranidial width (measurement 3, J) for *I. maximus*.

I.maximus A-2 vs. K-1

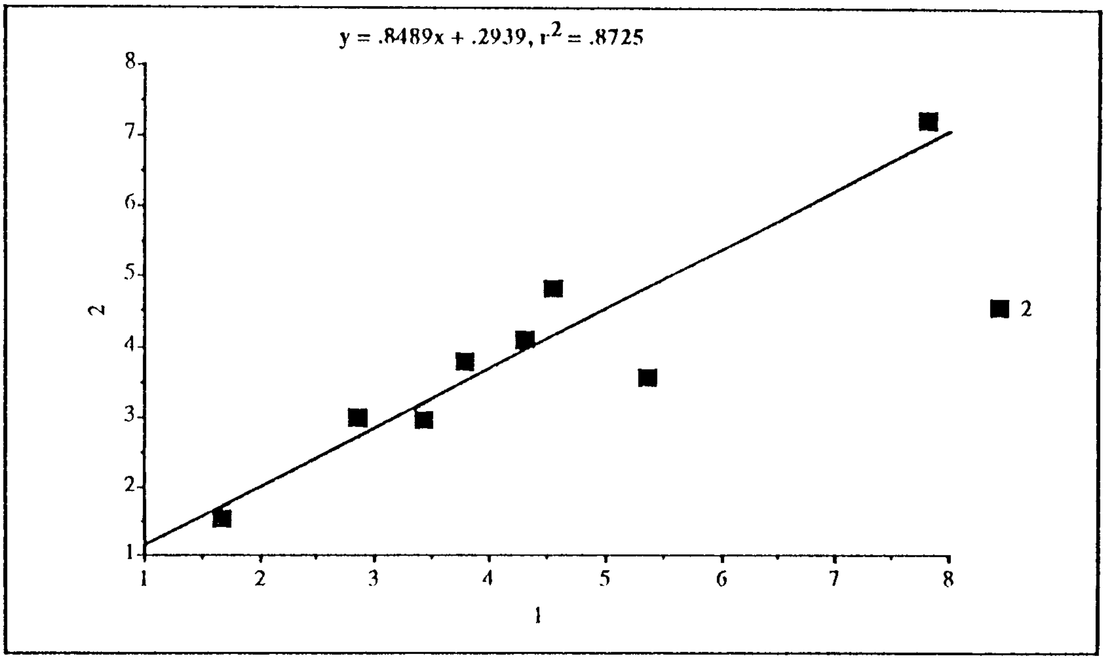


Figure 6. Regression analysis of cephalon length (Measurement 1, A2) versus palpebral glabellar width (measurement 2, K1) for *I. maximus.*

I.maximus A-2 vs. I-2

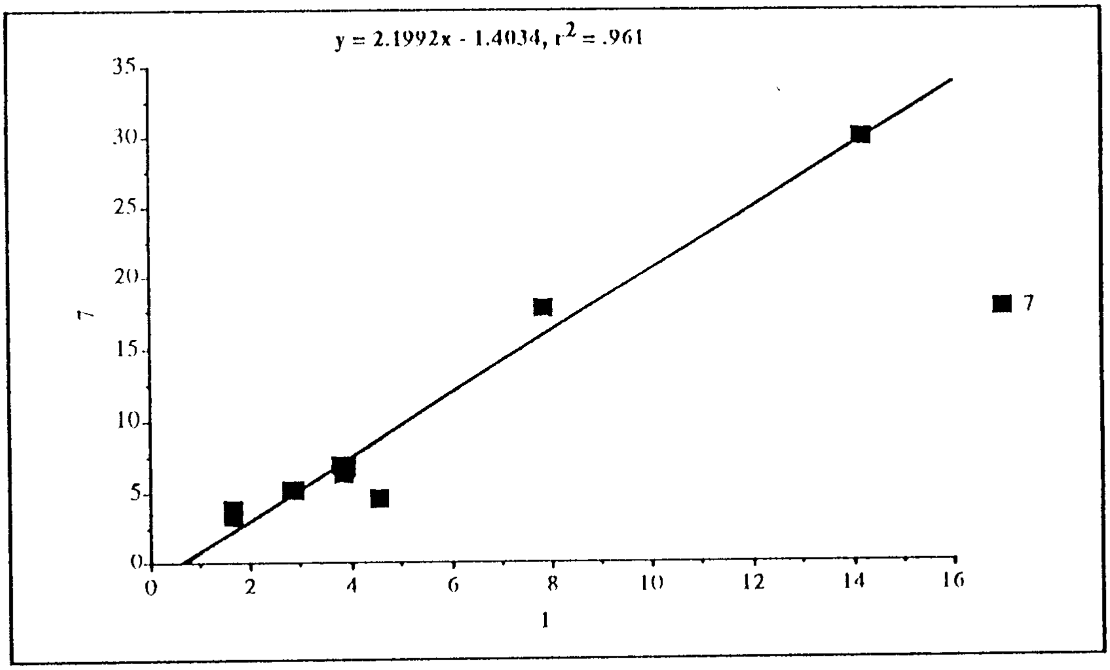


Figure 7. Regression analysis of cephalon length (Measurement 1, A2) versus occipital cephalic width (measurement 7, I2) for *I. maximus.*

I.maximus A-2 vs. J-1

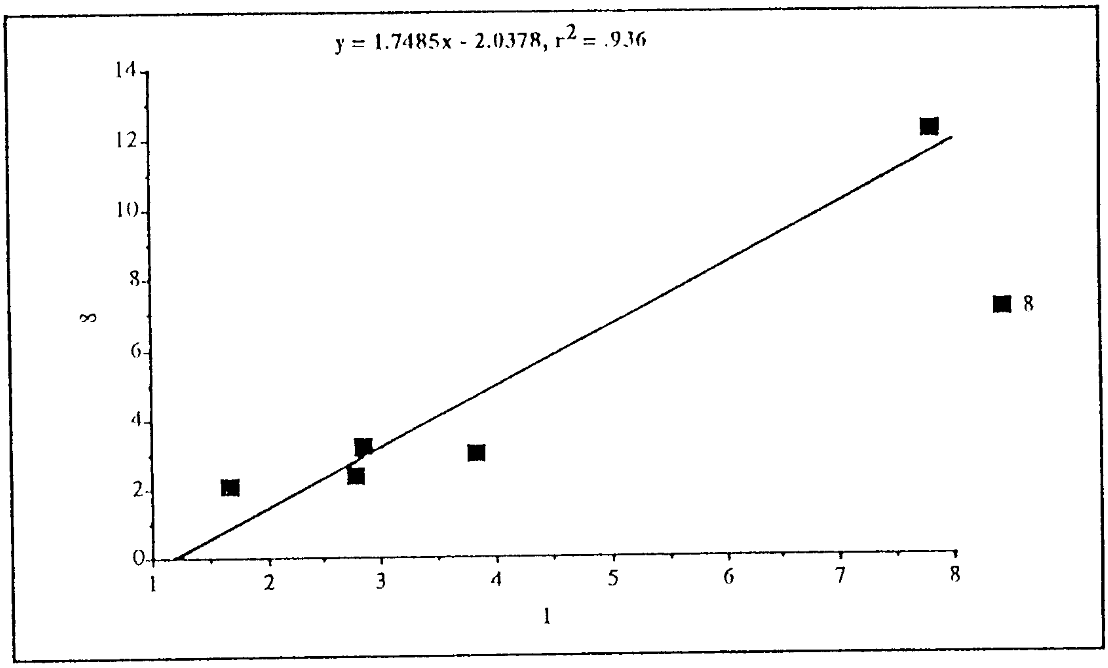


Figure 8. Regression analysis of cephalon length (Measurement 1, A2) versus posterior cranidial width (measurement 8, J1) for *I. maximus*.

I.maximus Z vs. X

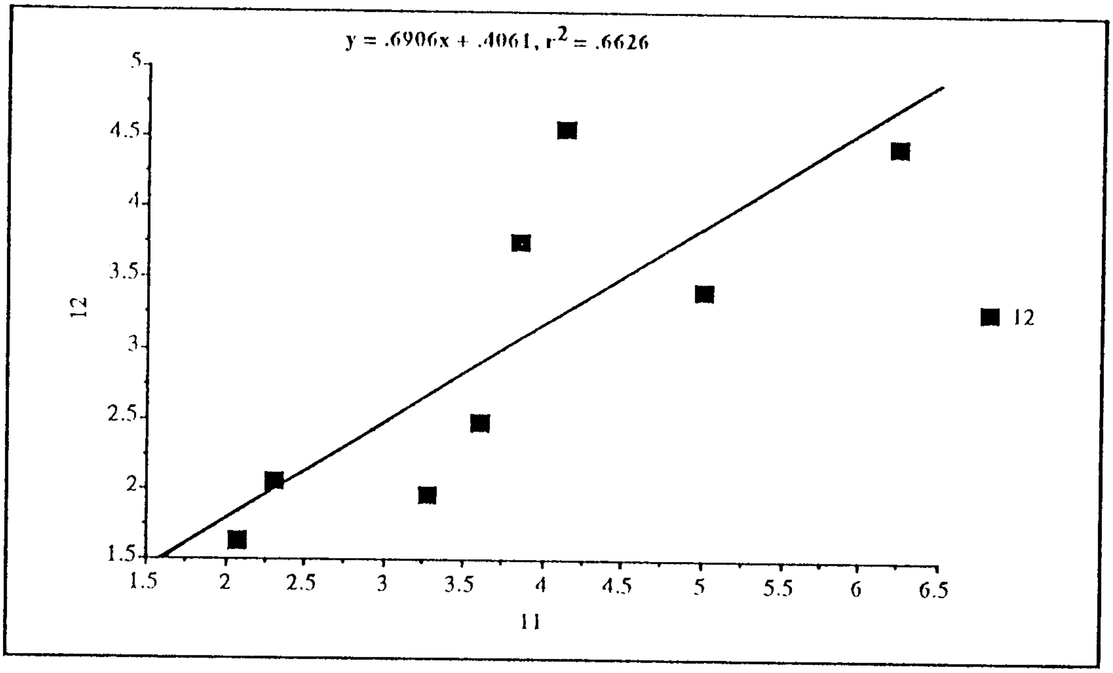


Figure 9. Regression analysis of length of pygidium (Measurement 11, Z) versus anterior width of rháchis (measurement 12, X) for *I. maximus*.

I.maximus 5 vs. J

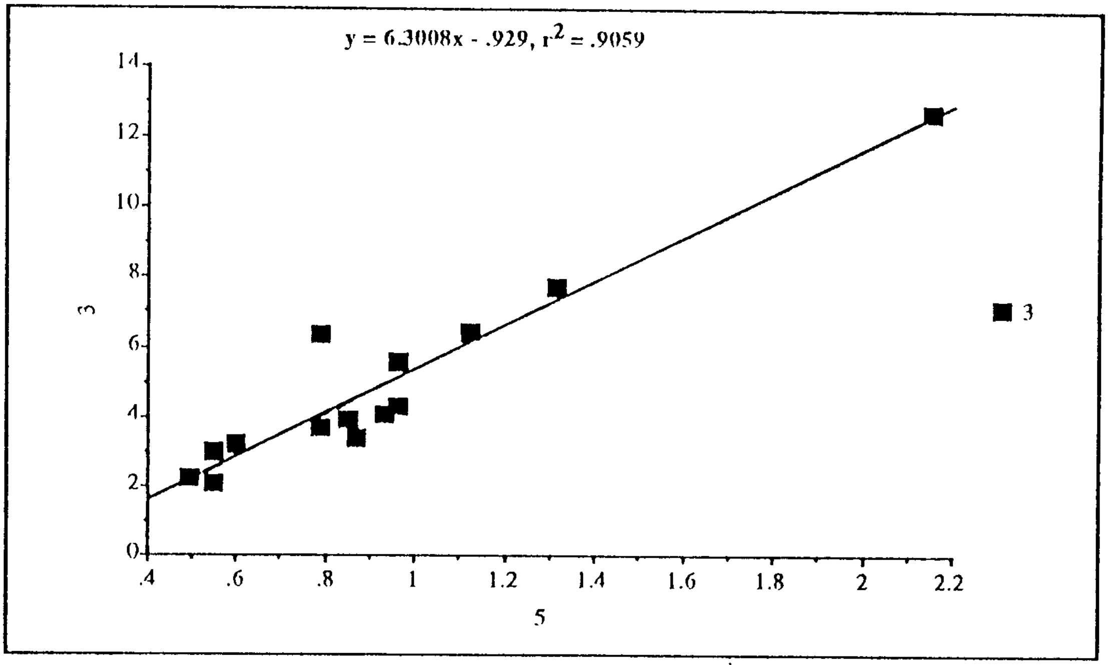


Figure 10. Regression analysis of length of eye (Measurement 5) versus palpebral cranidial width (measurement 3, J) for *I. maximus*.

I.maximus A-2 vs. 6

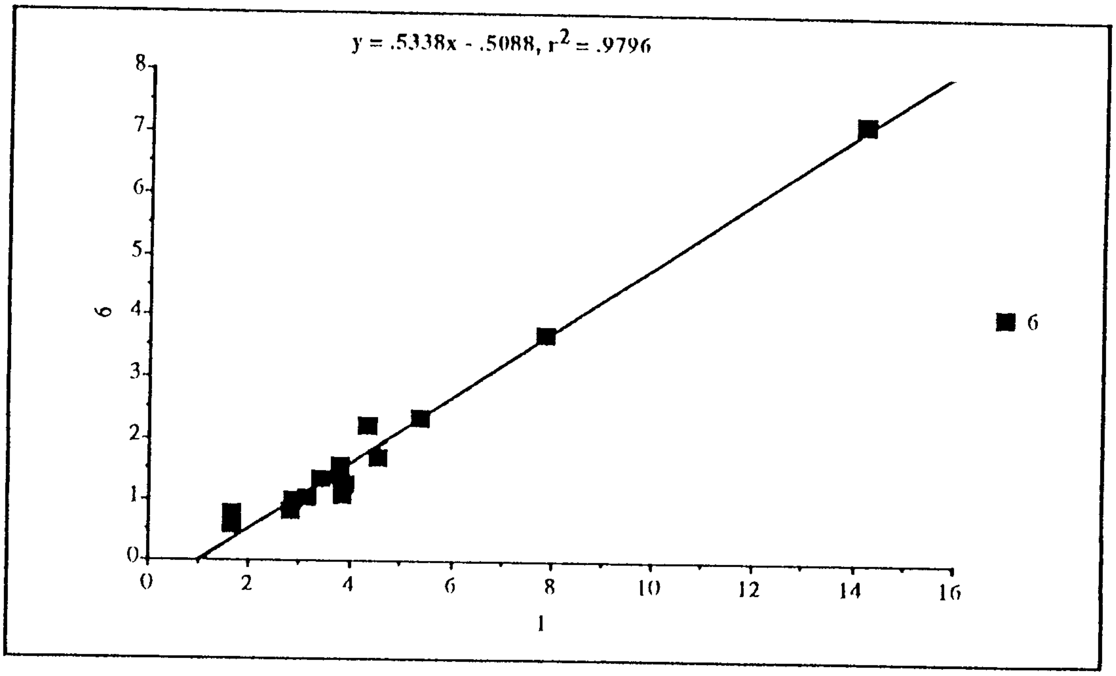


Figure 11. Regression analysis of cephalon length (Measurement 1, A2) versus width of free cheek to the middle of the eye (measurement 6) for *I. maximus*.

I.gigas Z vs. W

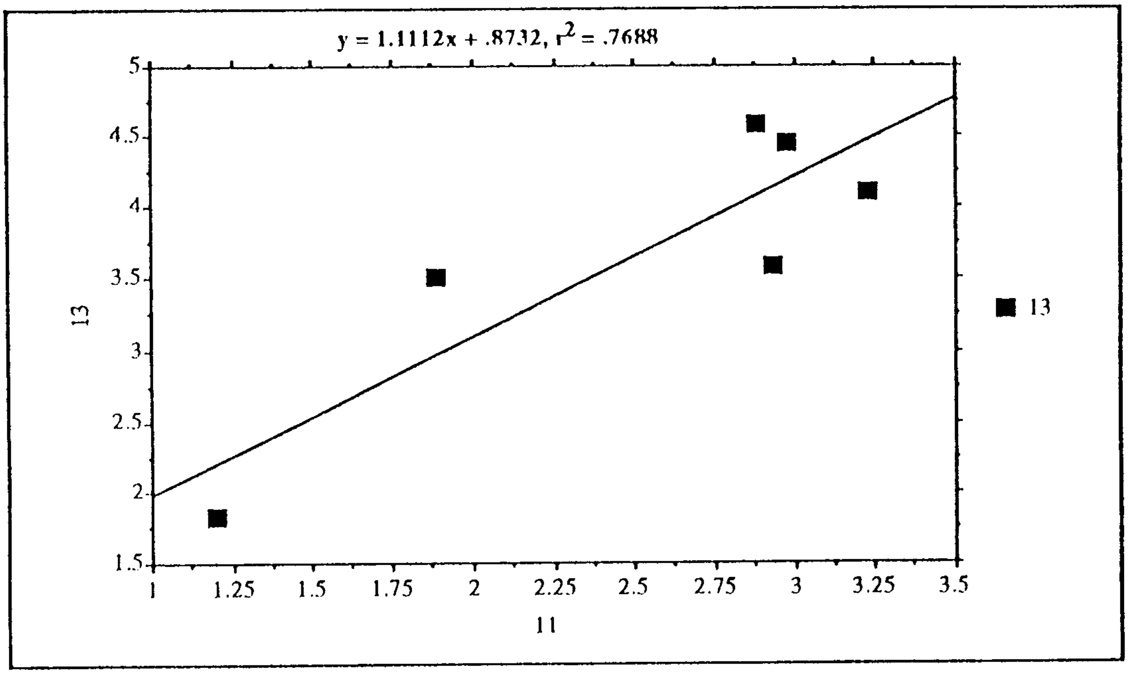


Figure 12. Regression analysis of pygidial length (Measurement 11, Z) versus pygidial width (measurement 13, W) for *I. gigas*.

I.gigas A-2 vs. J-5

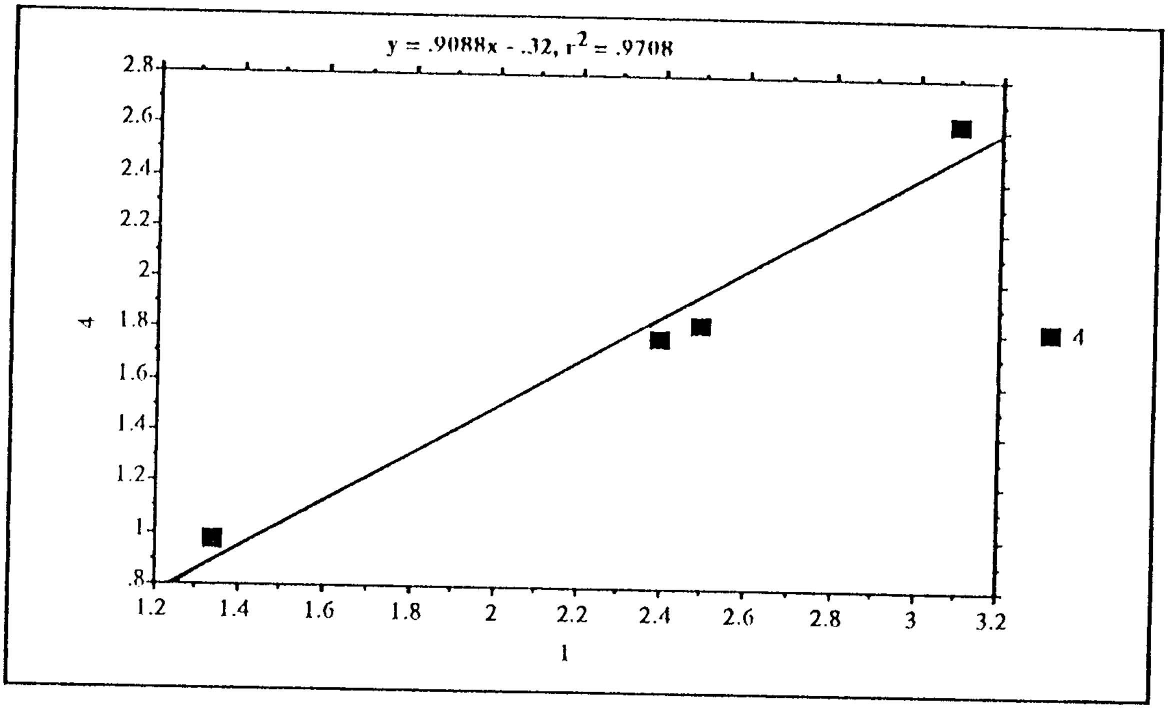


Figure 13. Regression analysis of cephalon length (Measurement 1, A2) versus post-palpebral cranidial width (measurement 4, J5) for *I. gigas*.

I.gigas A-2 vs. M-5

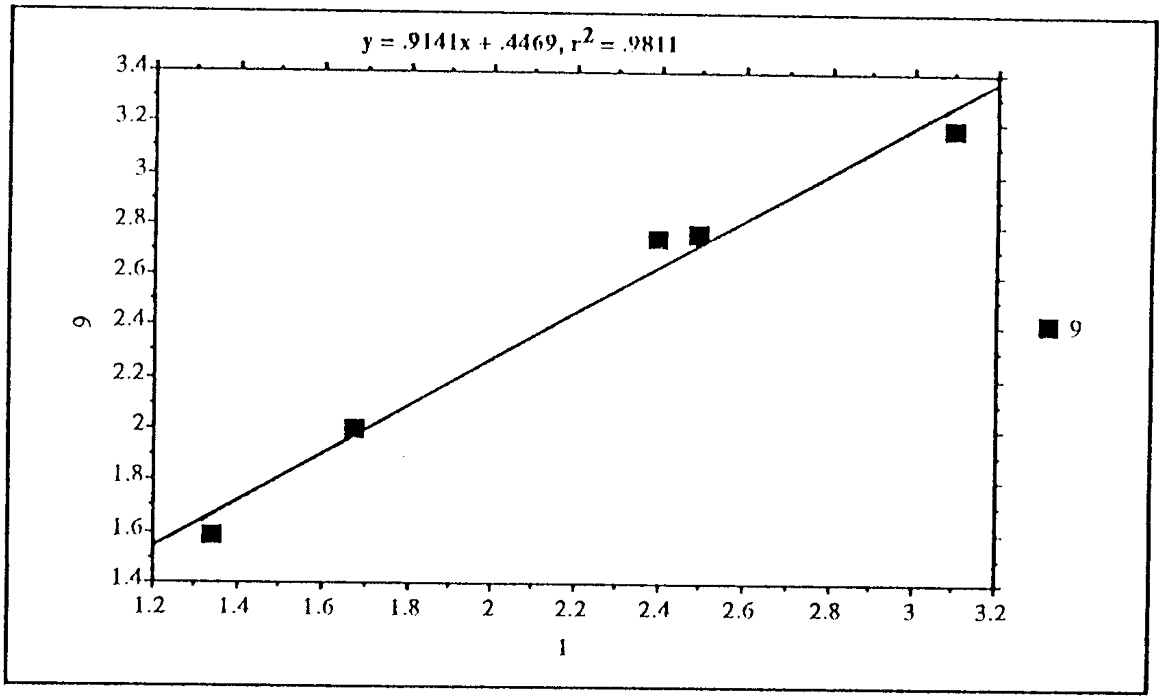


Figure 14. Regression analysis of cephalon length (Measurement 1, A2) versus length of free cheek (measurement 9, M5) for *I. gigas*.

I.gigas A-2 vs. J

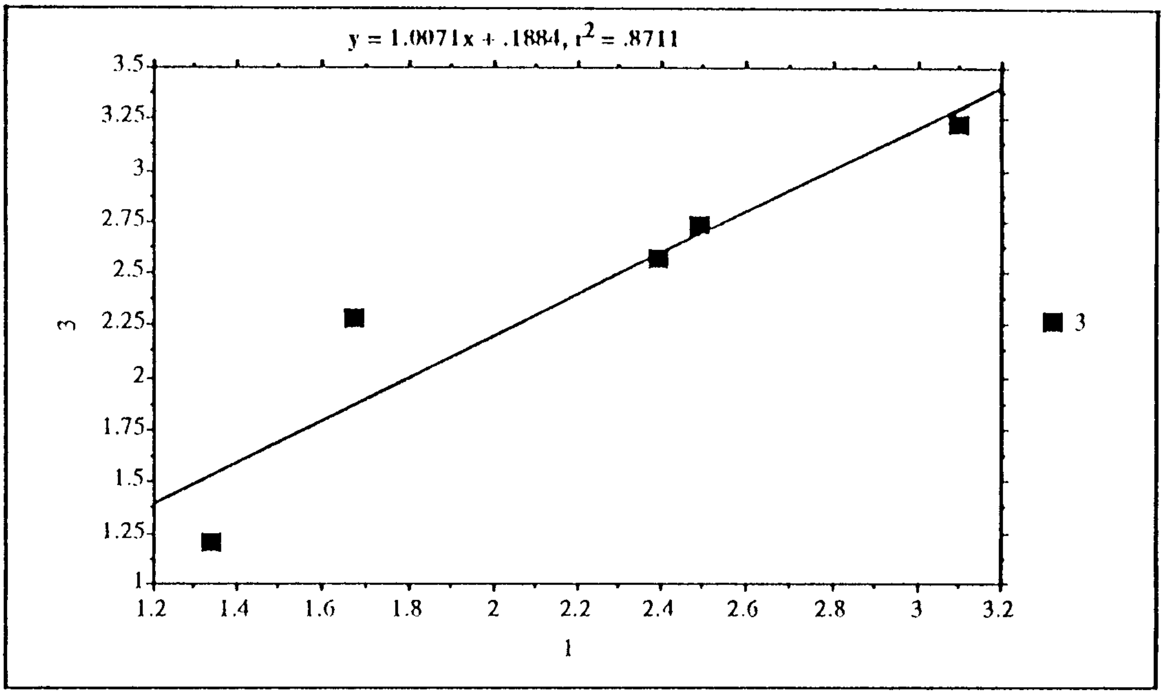


Figure 15. Regression analysis of cephalon length (Measurement 1, A2) versus palpebral cranidial width (measurement 3, J) for *I. gigas*.

I.gigas A-2 vs. I-2

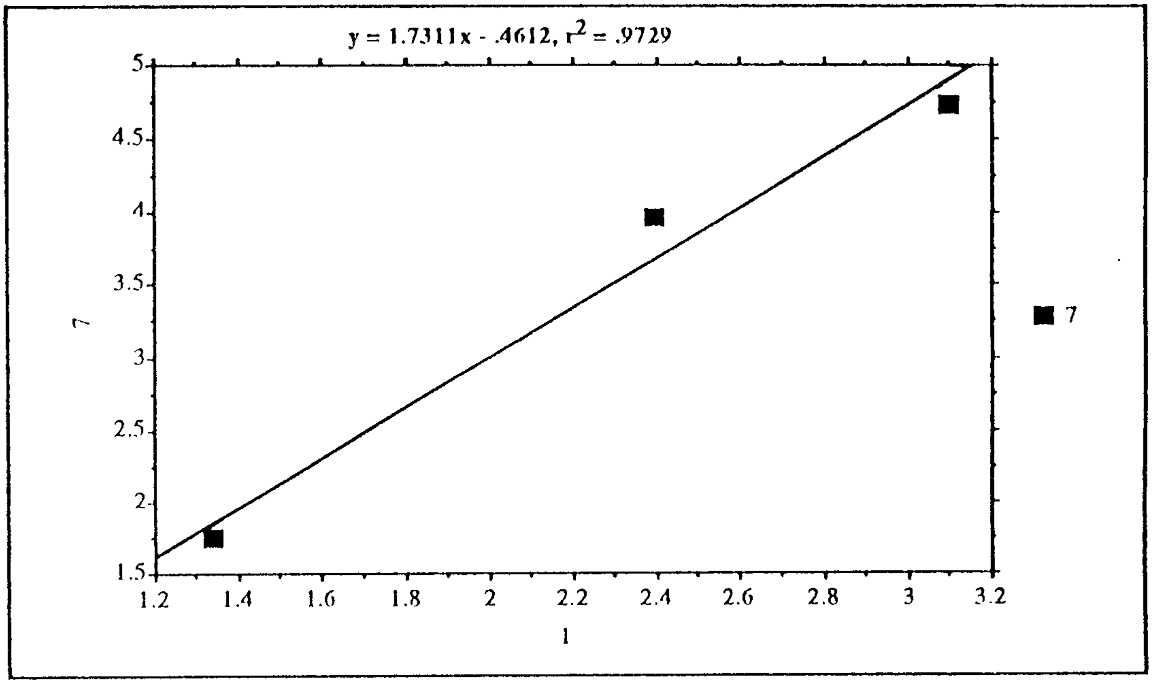


Figure 16. Regression analysis of cephalon length (Measurement 1, A2) versus occipital cephalic width (measurement 7, I2) for *I. gigas*.

I.gigas A-2 vs. J-1

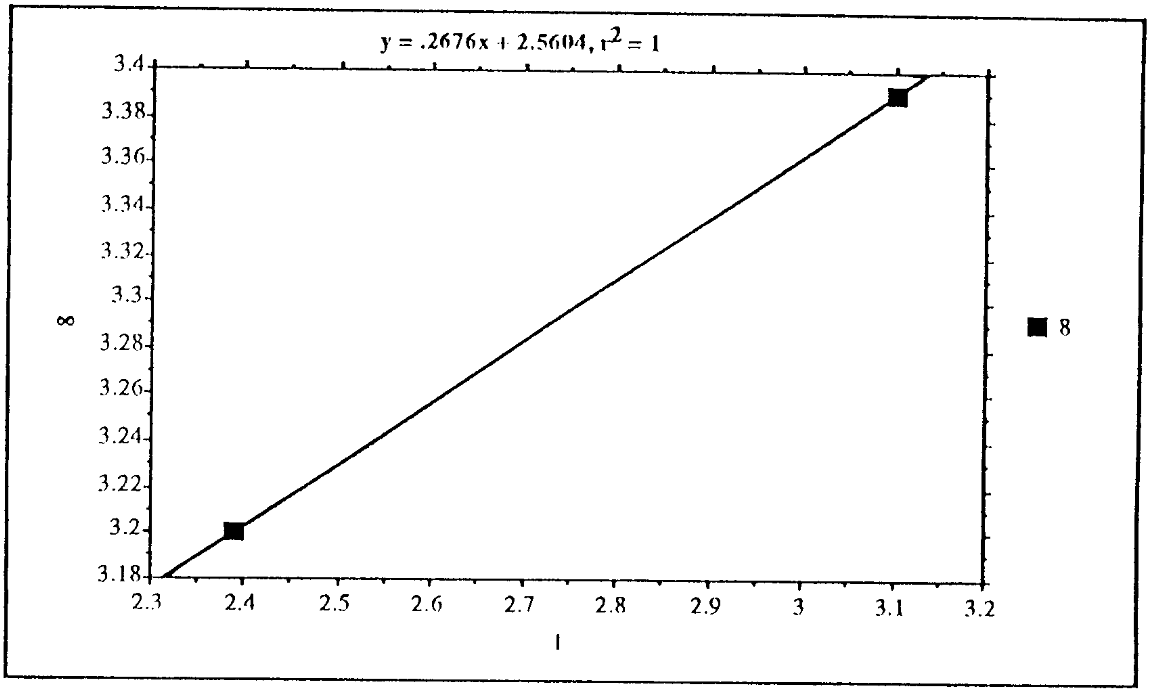


Figure 17. Regression analysis of cephalon length (Measurement 1, A2) versus posterior cranidial width (measurement 8, J1) for *I. gigas*.

I.gigas 5 vs. J

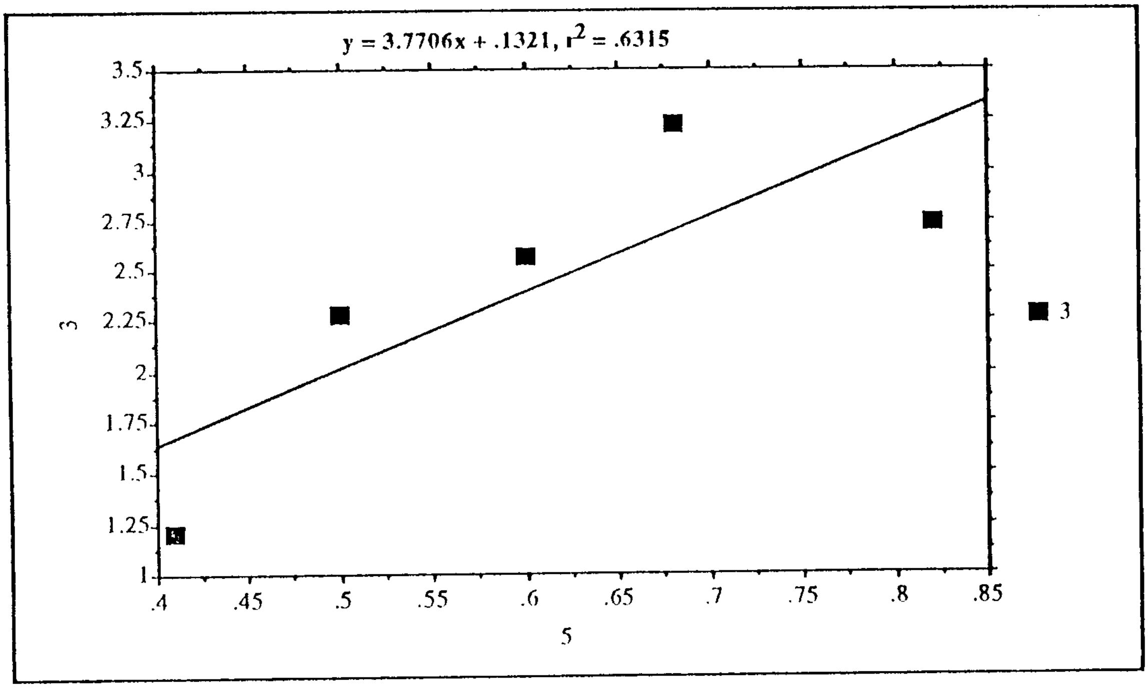


Figure 18. Regression analysis of length of eye (Measurement 5) versus palpebral cranidial width (measurement 3, J) for *I. gigas*.

I.gigas A-2 vs. 6

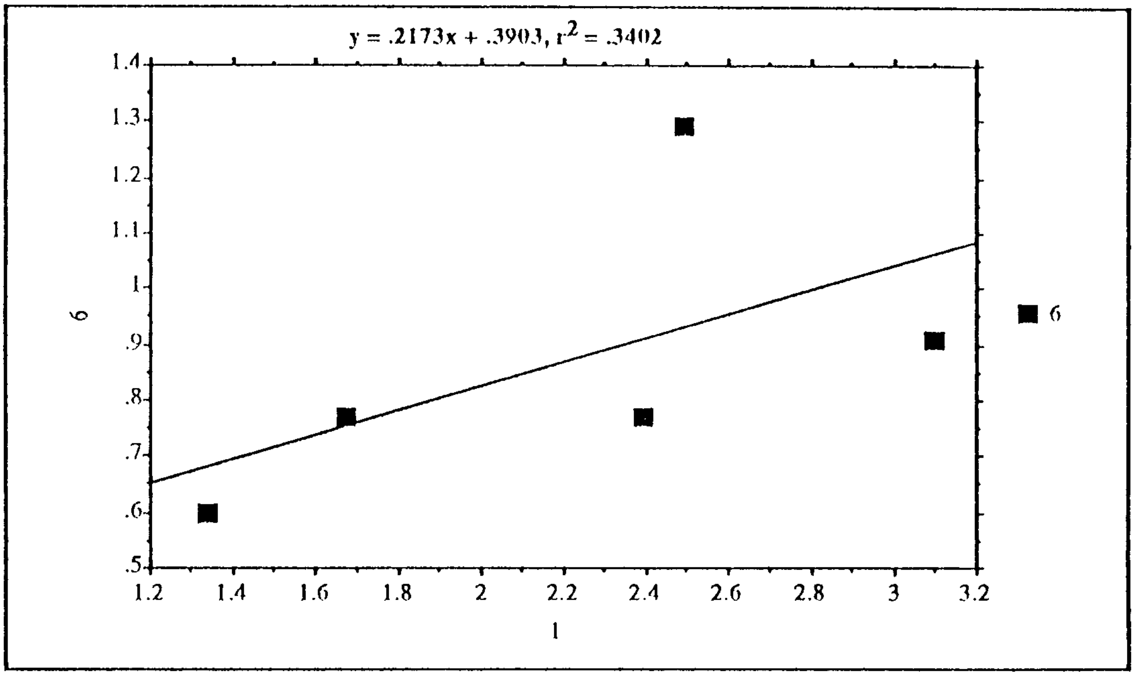


Figure 19. Regression analysis of cephalon length (Measurement 1, A2) versus width of free cheek to the middle of the eye (measurement 6) for *I. gigas*.

I.gigas Z vs. X

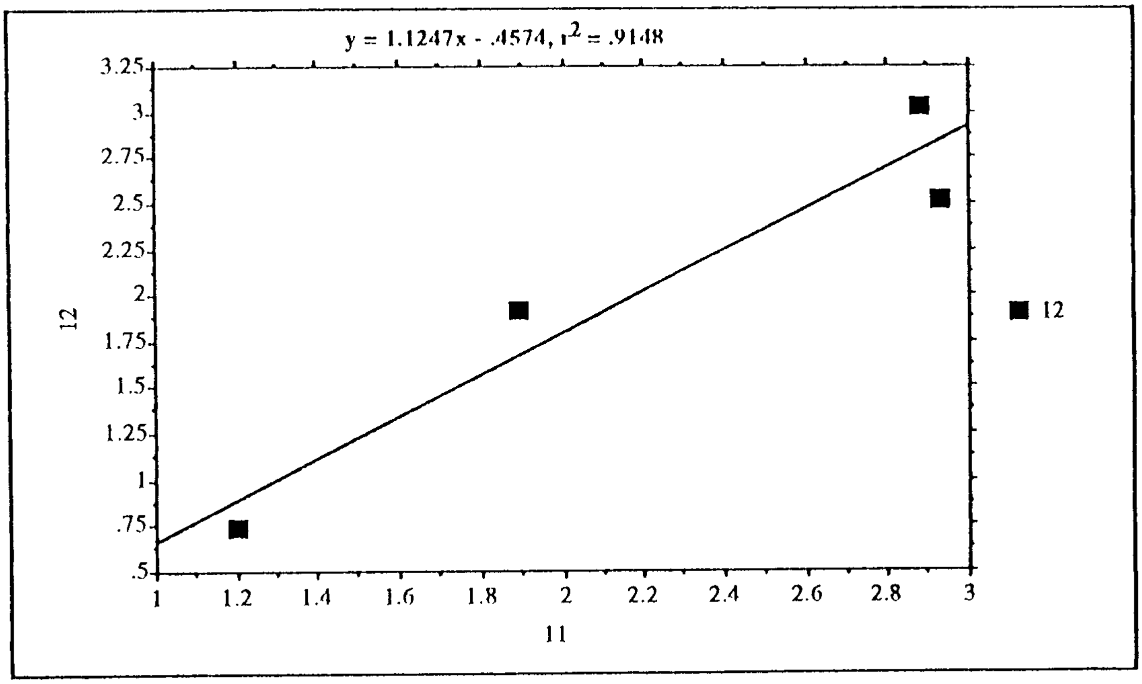


Figure 20. Regression analysis of length of pygidium (Measurement 11, Z) versus anterior width of rhachis (measurement 12, X) for *I. gigas*.

I.gigas A-2 vs. K-1

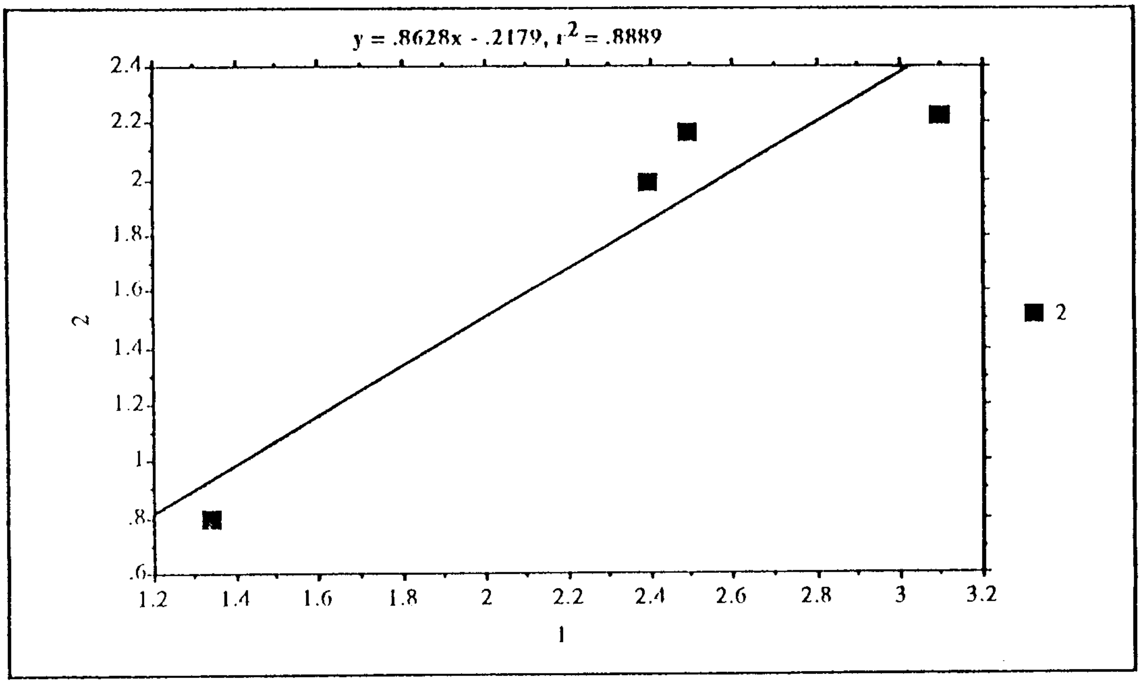


Figure 21. Regression analysis of cephalon length (Measurement 1, A2) versus palpebral glabellar width (measurement 2, K1) for *I. gigas*.

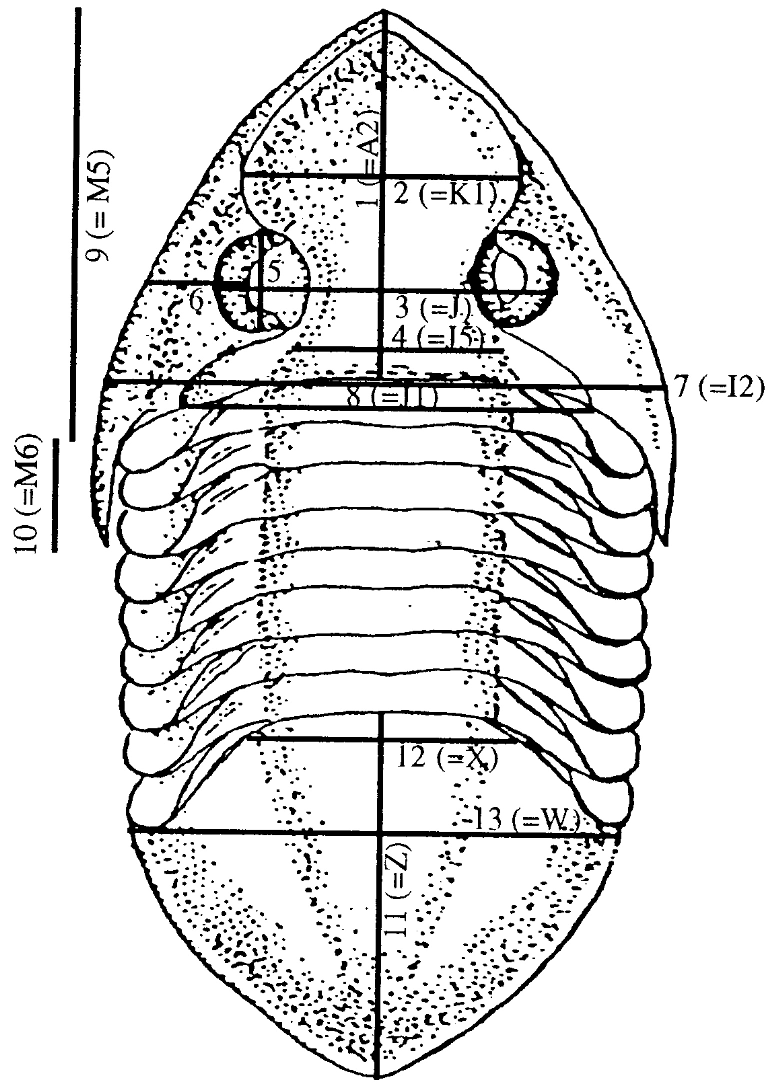


Figure 22. Diagram showing measured characters on *Isotelus*. Numbers refer to the order in which characters were measured using Optimus software and hardware, and equivalent descriptors given in parentheses refer to the standard variables of Shaw (1957) and Temple (1975).

Figure 23. *Isotelus* from Upper Ordovician (Cincincinnatian) rocks.

1. *Isotelus gigas* DeKay, dorsal view of uncompacted exoskeleton in limestone; Richmondian; Oxford, Ohio; x1; UCGM 39411.

2. *Isotelus maximus* Locke, dorsal view of uncompacted exoskeleton in limestone; Richmondian; Stonelick Creek, Ohio; x1; CiMNH P51.

3. *Isotelus maximus* Locke, labrum (hypostome); Cincinnati, Ohio; x0.75; UCGM 24364A.

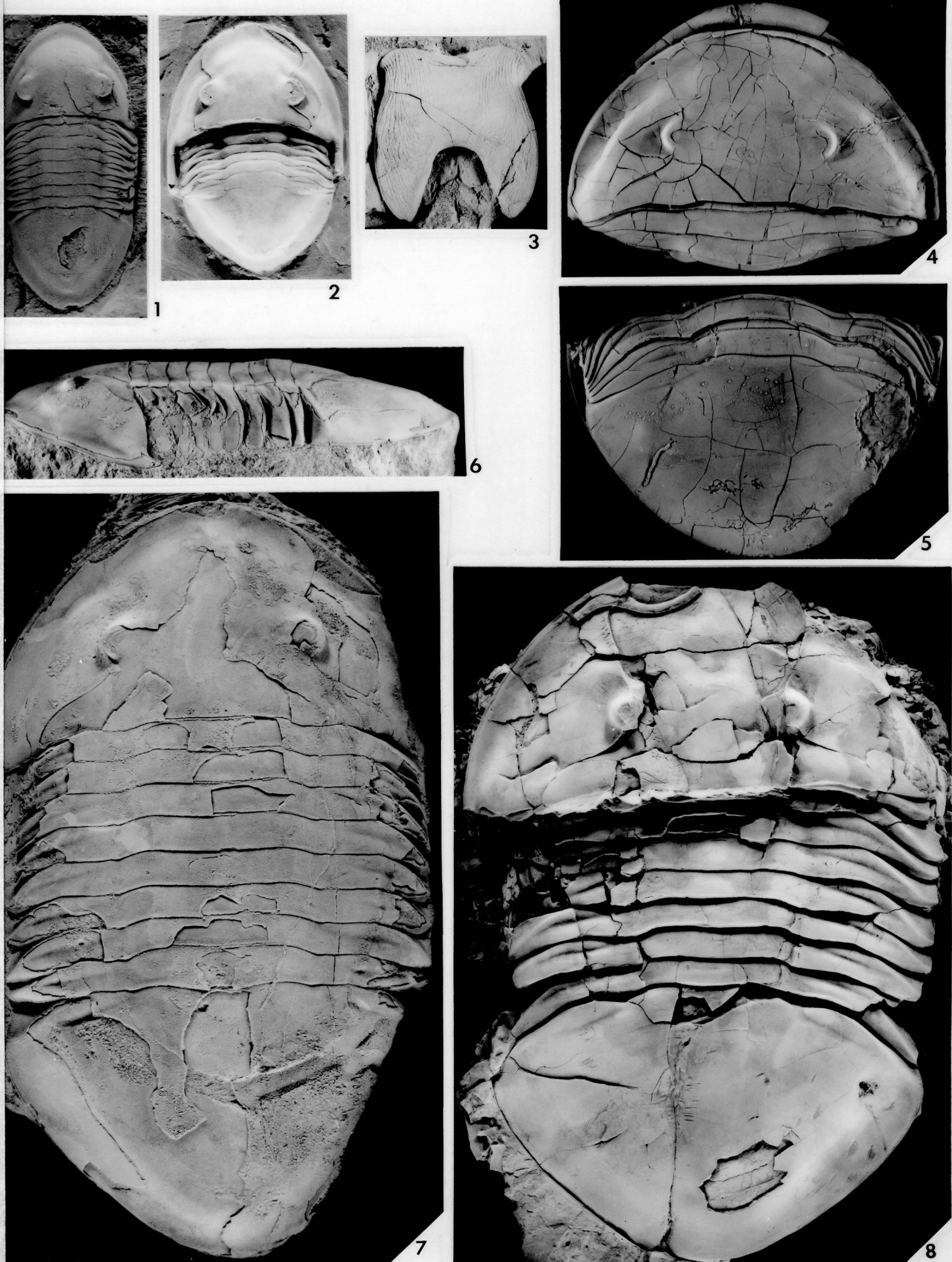
4. *Isotelus maximus* Locke, dorsal view of compacted specimen from calcareous shale; Arnheim Formation; Mt. Orab, Ohio; note encrusted bryozoan near center of cephalon and on first thoracic segment; x0.5; OSU unnumbered.

5. *Isotelus maximus* Locke, dorsal view , underside of same specimen as in Figure 23.4; note healed bite mark on right side of pygidium x0.5; OSU unnumbered.

6. *Isotelus maximus* Locke, lateral view; Liberty Formation; West Carrolton, Ohio; x0.5; OSU 32701.

7. *Isotelus maximus* Locke, dorsal view of exoskeleton, same specimen as in Figure 23.6; x0.75; OSU 32701.

8. *Isotelus maximus* Locke, dorsal view of highly compacted specimen found in calcareous shale; Richmondian?; Russellville, Ohio; x0.5; OSU 20492 .



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